

## A B S T R A C T

A drilling system for drilling a bore hole into an earth formation, the bore hole having an inside wall. A drill string reaches into the bore hole from a surface, leaving a drilling fluid return passage between the drill string and the bore hole inside wall. A bottom hole assembly is supported by the drill string, and a drilling fluid discharge conduit is provided in fluid communication with the drilling fluid return passage. A drilling fluid is pumped through the drill string into the bore hole and to the drilling fluid discharge conduit via the drilling fluid return passage. Means are provided for obtaining information on the existing down hole pressure of the drilling fluid in the vicinity of the bottom hole assembly and back pressure means for controlling the drilling fluid back pressure. Back pressure control means control the back pressure means, wherein the back pressure control means comprises a programmable pressure monitoring and control system arranged to receive the information on the existing down hole pressure, calculate a predicted down hole pressure using a model, compare the predicted down hole pressure to a desired down hole pressure, and to utilize the differential between the calculated and desired pressures to control said fluid back pressure means.